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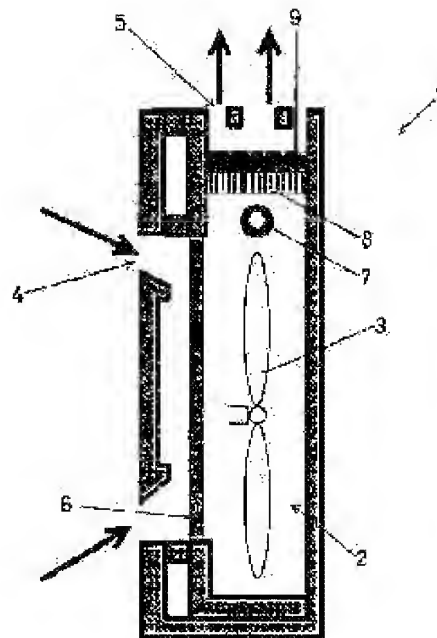
(54) PHOTOCATALYTIC AIR PURIFIER

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a photocatalytic air purifier which reliably adsorbs an intermediate product on an adsorbent layer and prevents discharge to the outside even if the intermediate product having low adsorbability to a photocatalyst layer is produced by making a light source opposite to the photocatalyst layer in a ventilation pass and disposing the adsorbent layer on the downstream side of the photocatalyst layer and the light source.

SOLUTION: In the photocatalytic air purifier 1, external air sucked from a suction opening 4 by a blower fan 3 in a ventilation pass 2 is spouted from a nozzle 5. A fiber filter 6, the blower fan 3, a light source 7 which excites a photocatalyst, a photocatalyst layer 8 and an adsorbent layer 9 are successively disposed in the ventilation pass 2 from the upper stream side.

The light source 7 is made opposite to the photocatalyst layer 8 and the adsorbent layer 9 is disposed in close contact with the photocatalyst layer 8 on the downstream side. Organic substances such as malodorous components adsorbed on the photocatalyst layer 8 are subjected to oxidation decomposition by irradiation with excitation light from the light source 7. Even if an intermediate product having low adsorbability to the photocatalyst layer 8 is produced, it can reliably be adsorbed on the adsorbent layer 9.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the air cleaner using the photocatalyst which purifies the bad smell and toxic substance by which it is generated in a home, an office, etc.

[0002]

[Description of the Prior Art] The air cleaner of composition of having established the active carbon layer in the windward of a photocatalyst layer which is indicated by JP,1-159032,A as an air cleaner using a photocatalyst conventionally is known. This air cleaner has provided the photocatalyst layer most in the leeward side in a ventilation flue.

Let air which carried out non-bromination be a discharge plug by decomposing an odor component etc. here.

[0003]

[Problem(s) to be Solved by the Invention] However, generally, since the reaction of a photocatalyst effect is slow compared with the adsorbing action of adsorbent, such as activated carbon, in the air cleaner of the above-mentioned composition, before an odor component and a detrimental constituent are decomposed thoroughly, it passes a photocatalyst layer, and the case where it is emitted outside as it is may produce it. When the scarce intermediate product of the adsorption capability to a photocatalyst layer generated in the decomposition process by photocatalyst activity especially, after that, most intermediate products passed the photocatalyst layer, while not having been decomposed by it, and there was a problem of emitting the intermediate product as a new odor component or a toxic substance outside.

[0004] If an example is given and explained, when ammonia will be disassembled by photocatalyst activity, it is generated by nitric oxide and nitrogen dioxide as an intermediate product in the decomposition process. Since the adsorption capability to a photocatalyst layer is high about nitric oxide, it is further decomposed by the photocatalyst after that, but since the adsorption capability to a photocatalyst layer is low about nitrogen dioxide, a photocatalyst layer is passed as it is and there is a

possibility that it may be emitted outside.

[0005]The deodorization apparatus of composition of having added the photocatalyst to the adsorption material indicated by the registration-of-patent No. 2574840 gazette as what solves such a problem is known. When a photocatalyst is scoured on the surface of adsorption material and it scours a photocatalyst to addition or adsorption material, this tends to make an odor component with slow catabolic rate once stick to the adsorption material excellent in adsorption capability, and tends to decompose the odor component in adsorption material gradually in an operation of a photocatalyst after that.

[0006]However, the following problems arise in the deodorization apparatus of the above-mentioned composition. That is, in the conventional air cleaner, the high substance of the boiling point with comparatively small polarity is made to stick to adsorbent, and a photocatalyst decomposes the polar low large substance of the boiling point. Therefore, both can purify air thoroughly only after they can fully function.

[0007]However, like the deodorization apparatus of the above-mentioned composition, after the photocatalyst has added, the original adsorption capability of adsorption material declines and the time which purification of air takes as a result becomes long. Although a photocatalyst can be used semipermanently essentially, since all are not decomposed by the photocatalyst, the odor component to which it stuck about adsorption material is not avoided that adsorption capability declines with use.

[0008]Although adsorption material needs to be exchanged at this time, in that case, the whole photocatalyst of a still sufficiently usable state must be exchanged, and the problem that cost becomes high arises.

[0009]Then, it aims at providing the air cleaner which can solve the above-mentioned problem in this invention.

[0010]

[Means for Solving the Problem]In order to attain the above-mentioned purpose, in a photocatalyst air cleaner concerning this invention, it had an adsorbent layer and a light source for exciting a photocatalyst layer and a photocatalyst all over a ventilation flue, this light source was countered and provided in a photocatalyst layer, and said adsorbent layer was provided in leeward side of a photocatalyst layer and a light source.

[0011]If such composition is adopted, toxic substances which stuck to a photocatalyst layer, such as an organic matter system odor component, nitrogen oxides, and a sulfur oxide, will be disassembled by photocatalyst activity by irradiating a photocatalyst layer with excitation light from a light source.

[0012]In the decomposition process, even when a scarce intermediate product of adsorption capability to a photocatalyst layer generates, discharge of an intermediate product to the device exterior can be prevented by adsorbing an intermediate product by an adsorbent layer allocated in leeward side of a photocatalyst layer. In the case of nitrogen dioxide generated at the time of the above-mentioned ammonolysis, it becomes possible by, for example, choosing high adsorbent of adsorption capability of nitrogen dioxide like activated carbon to control discharge outside.

[0013>About an installed position of an adsorbent layer, as long as it is on the leeward of a

photocatalyst layer and a light source, it may be any position, but if an adsorbent layer is stuck to a photocatalyst layer, a photocatalyst can decompose gradually an intermediate product by which an adsorbent layer was adsorbed in both layer interfaces.

[0014]Cleaning capacity of an air cleaner can be returned only by exchanging only adsorbent layers for the above-mentioned adsorbent, when [removal is independently possible, then] adsorption capability of an adsorbent layer declines.

[0015]If extraction of only adsorbent is made possible when adsorbent is made to exist in a photocatalyst layer and adsorption capability declines apart from an adsorbent layer, an intermediate product can be made to be once able to stick to adsorbent, and a photocatalyst can decompose efficiently after that. And since exchange of only adsorbent is possible, in a cost aspect, it is advantageous.

[0016]When a photocatalyst layer is formed in honeycomb shape, specifically, it can be made an inside of a honeycomb with granular or composition which piles up adsorbent formed in nonwoven fabric state, a sheet shaped, etc. when it is filled up with a proper quantity of adsorbent, such as fiber-like activated carbon, or a photocatalyst layer is formed in mesh shape or a sheet shaped.

[0017]In an air cleaner of the above-mentioned composition, if exterior air is directly taken in to a photocatalyst layer, a possibility of dust and haze adhering on the surface of a photocatalyst, and having an adverse effect on decomposition capability of a photocatalyst will arise.

[0018]Then, in this invention, composition which provides a dust collection part which catches dust and haze of submicron order in the windward of a photocatalyst layer and a light source was made employable. If it has such composition, a fall of decomposition capability of a photocatalyst can be prevented. As a dust collection part, a fiber filter which consists of several microns microscopic thin textiles, and an electrostatic precipitator can be used.

[0019]The photocatalyst refers to what works as a catalyst of a chemical reaction by absorbing light. If the photocatalyst surface is irradiated, an electron will be excited from a conducting zone and charge separation to an electron hole and an electron will arise. By making an oxidation-reduction reaction by electron transfer cause on this surface, an odor component and a toxic component are decomposed, respectively and it becomes possible non-bromination and to detoxicate.

[0020]As a photocatalyst, although it is preferred to use high titanium oxide of activity generally, metallic oxides, such as tungstic oxide, a zinc oxide, and copper oxide, can be used. These metallic oxides may be used alone and can also use the complex.

[0021]However, even if light is irradiated by photocatalyst which consists of metallic oxides and an electron hole and an electron arise, Since most of electron holes and electrons are recombined, high photocatalyst activity is not acquired, but a reaction by-product or an intermediate product generated by a late substance and a photocatalyst effect of catabolic rate adheres on the surface of a photocatalyst, and there is a possibility of causing a photocatalyst activity fall.

[0022]Then, in this invention, a thing of composition using metal particle support which made the surface of a simple substance of a metallic oxide or its complex support metal particles was made employable as a photocatalyst. As metal particles used here, platinum with a particle diameter of 1-10

nm, palladium particles, etc. are mentioned.

[0023] Since an electron produced by the exposure of light can be drawn near to metal particles and recombination with an electron hole will be barred if such composition is adopted, It becomes possible to acquire high photocatalyst activity, and decomposition removal is carried out promptly and a late substance, a reaction by-product, or an intermediate product of catabolic rate, etc. can prevent a photocatalyst activity fall.

[0024] As adsorbent in this invention, a simple substance of zeolite, Ms. Cana Ito, mordenite, porous silica, porosity alumina, sepiolite, a molecular sieve, cordierite, activated carbon, and metal ion exchange zeolite or its complex can be used.

[0025] Although not limited especially as shape of a photocatalyst layer and an adsorbent layer, it is preferred to consider it as honeycomb shape, nonwoven fabric state, or the shape of a bellows also in it. It is because surface area of a photocatalyst layer and an adsorbent layer becomes large and adsorption performance and photocatalyst activity increase.

[0026]

[Embodiment of the Invention] Hereafter, an embodiment of the invention is described based on a drawing. Drawing 1 is a sectional view showing the embodiment of the photocatalyst air cleaner concerning this invention. The ventilation flue 2 is formed in a device and this photocatalyst air cleaner 1 has the structure where the exterior air taken in from the suction opening 4 with the blower fan 3 installed in the inside of the ventilation flue 2 is emitted from the outlet 5. In the ventilation flue 2, the light source 7 for exciting the fiber filter 6, the blower fan 3, and a photocatalyst from the windward, the photocatalyst layer 8 of honeycomb shape, and the adsorbent layer 9 are allocated by this order, respectively.

[0027] The light source 7 counters the photocatalyst layer 8, and the adsorbent layer 9 is installed in leeward side in the state where it stuck to the photocatalyst layer 8. The exterior air having contained the odor component and the detrimental constituent enters from the suction opening 4, and dust, haze, etc. in the air are caught by passing the fiber filter 6, Toxic substances, such as odor components, such as a tobacco smell in the air, a toilet smell, a pet smell, and a cooking smell, a building-materials smell, and exhaust gas, are removed by passing the photocatalyst layer 8.

[0028] By furthermore passing the adsorbent layer 9, an odor component, a toxic substance, etc. which were not able to be removed by the photocatalyst layer 8 are removed, and the purified air is emitted outside from the outlet 5. With the photocatalyst activated by the ability to irradiate with excitation light from the light source 7, oxidative degradation of the organic substances which stuck to the photocatalyst layer 8, such as an odor component, is carried out, they become a water molecule, carbon dioxide, etc., and are emitted outside.

[0029] Since the adsorbent layer 9 adsorbs even if it is a case where the low intermediate product of the adsorption capability to the photocatalyst layer 8 generates in the decomposition process by photocatalyst activity at this time, discharge outside can be prevented.

[0030] The photocatalyst layer 8 and the adsorbent layer 9 in this embodiment were produced by the following methods.

[0031](Production of a photocatalyst layer) Coating liquid was prepared as a photocatalyst, using colloidal silica (the product made from Tell Nick Industry, BETAKKU 970) as titanium oxide powder (Product made from the Ishihara Techno, ST-01), and a binder. Coating liquid was prepared so that titanium oxide in solid content and the weight ratio of colloidal silica might be set to 1:1.

[0032]Thus, the honeycomb substrate made from aluminum of 200 cells / inch² (300x90x18mm) was immersed in the prepared coating liquid, and it was made to support 100 g per substrate volume of 1l. of solid content (in this embodiment, it is 49g of solid content) to a base material surface. Then, it heat-treated at 150 °C for 1 hour, and the photocatalyst layer 8 was produced.

[0033](Production of an adsorbent layer) Coating liquid was prepared as adsorbent, using colloidal silica (the product made from Tell Nick Industry, BETAKKU 970) as activated carbon powder (Product made from KYATARA, activated-carbon-from-wood powder), and a binder. Coating liquid was prepared so that the activated carbon in solid content and the weight ratio of colloidal silica might be set to 1:1.

[0034]Thus, the honeycomb substrate made from aluminum of 200 cells / inch² (300x90x18mm) was immersed in the prepared coating liquid, and it was made to support 100 g per substrate volume of 1l. of solid content (in this embodiment, it is 49g of solid content) to a base material surface. Then, it heat-treated at 150 °C for 1 hour, and the adsorbent layer 9 was produced.

[0035]Drawing 2 is a sectional view showing a 2nd embodiment of the photocatalyst air cleaner concerning this invention. These photocatalyst air cleaners 1 differ the point that the photocatalyst layer 8 is formed in two places, the windward and leeward side, on both sides of the light source 7, and in that the blower fan 3 is installed most in leeward side, although fundamental composition is the same as the photocatalyst air cleaner 1 in a 1st embodiment.

[0036]That is, the fiber filter 6, the photocatalyst layer 8, the light source 7, the photocatalyst layer 8, the adsorbent layer 9, and the blower fan 3 as a dust collection part are allocated by this order from the windward, respectively in the ventilation flue 2 in the photocatalyst air cleaner 1 in this embodiment.

[0037]If it has such composition, it will become possible to acquire a catalysis higher than the case where the thickness of the photocatalyst layer 8 is doubled simply. That is, to a catalysis becoming weak since the light volume irradiated decreases, when the thickness of the photocatalyst layer 8 is doubled, since the light volume irradiated does not decrease, by this embodiment, it becomes possible to double photocatalyst ability in the end piece of the photocatalyst layer 8. Therefore, the light source 7 can obtain as [one] the photocatalyst air cleaner 1 which has high throughput with an easy structure.

[0038]Drawing 3 is a sectional view showing another embodiment of an adsorbent layer. After this adsorbent layer 9 puts granular active carbon between the sheets which have the breathability of two sheets for granular active carbon and makes it a thick sheet shaped, it is made crooked in the shape of a bellows. Since surface area will become large compared with sheet shaped mere photocatalyst layer 8 and adsorbent layer 9 if this is used combining the photocatalyst layer 8 of honeycomb shape, it becomes possible to raise the photocatalyst activity of a photocatalyst, and the adsorption

performance of adsorbent.

[0039]

[Effect of the Invention]According to this invention, by having provided the adsorbent layer in the leeward side of the photocatalyst layer and the light source so that clearly from the above explanation, Even if it is a case where the scarce intermediate product of the adsorption capability to a photocatalyst layer generates in the decomposition process by photocatalyst activity, since it adsorbs by an adsorbent layer, it becomes possible to prevent discharge of the intermediate product to the exterior.

[0040]It becomes possible by sticking an adsorbent layer to a photocatalyst layer to disassemble gradually the intermediate product by which the adsorbent layer was adsorbed in both layer interfaces with a photocatalyst.

[0041]The cleaning capacity of a device can be returned only by exchanging only adsorbent layers for the above-mentioned adsorbent layer, when [removal is independently possible, then] the adsorption capability of an adsorbent layer declines.

[0042]If extraction of only adsorbent is made possible when adsorbent is made to exist in a photocatalyst layer and adsorption capability declines apart from an adsorbent layer, an intermediate product can be made to be able to stick to adsorbent and the crepuscular-rays catalyst can decompose efficiently.

[0043]If the dust collection part which catches the dust and haze of submicron order is provided in the windward of a photocatalyst layer and a light source, the fall of the decomposition capability of a photocatalyst can be prevented.

[0044]If the metal particle support which made the surface of the simple substance of a metallic oxide or its complex support metal particles is used, Photocatalyst activity can be improved, even if a reaction by-product or an intermediate product generated by the late substance and photocatalyst effect of catabolic rate adheres on the surface of a photocatalyst, decomposition removal is carried out promptly, and it becomes possible to prevent the fall of photocatalyst capability.

[0045]If shape of a photocatalyst layer and an adsorbent layer is made into honeycomb shape, nonwoven fabric state, a sheet shaped, or the shape of a bellows, the surface area of a photocatalyst layer and an adsorbent layer will become large, and adsorption performance and photocatalyst activity will increase.

[Translation done.]